TM 11-964A

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RECTIFIER RA-91-B

DEPARTMENT OF THE ARMY • *AUGUST 1951*

AGO-302B—Aug.

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United States Government Printing Office
Washington: 1951

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *15 August 1951*

TM 11–964A is published for the information and guidance of all concerned.

[AG 412.42 (13 Jul 51)]

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AGO–302B

CONTENTS

		Paragraphs	Page
CHAPTER 1. INTRODUCTION			
Section I.	General	1– 2	1
II.	Description and data	3– 6	1
CHAPTER 2. OPERATING INSTRUCTIONS			
Section I.	Service upon receipt of material	7–10	4
II.	Controls and instruments	11–14	8
III.	Operation under usual conditions	15–18	9
IV.	Operation under unusual conditions	19–22	11
CHAPTER 3. ORGANIZATIONAL MAINTENANCE INSTRUCTIONS			
Section I.	Preventive maintenance services	23–25	12
II.	Preservation	26–27	12
CHAPTER 4. THEORY		28–29	14
5. FIELD MAINTENANCE INSTRUCTIONS			
Section I.	General	30–31	17
II.	Trouble location	32–34	17
III.	Disassembly, assembly, and final testing	35–36	21
CHAPTER 6. SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE			
Section I.	Shipment and limited storage	37–38	24
II.	Demolition to prevent enemy use	39–40	24
APPENDIX I. REFERENCES			26
II. IDENTIFICATION TABLE OF PARTS			29
INDEX			31

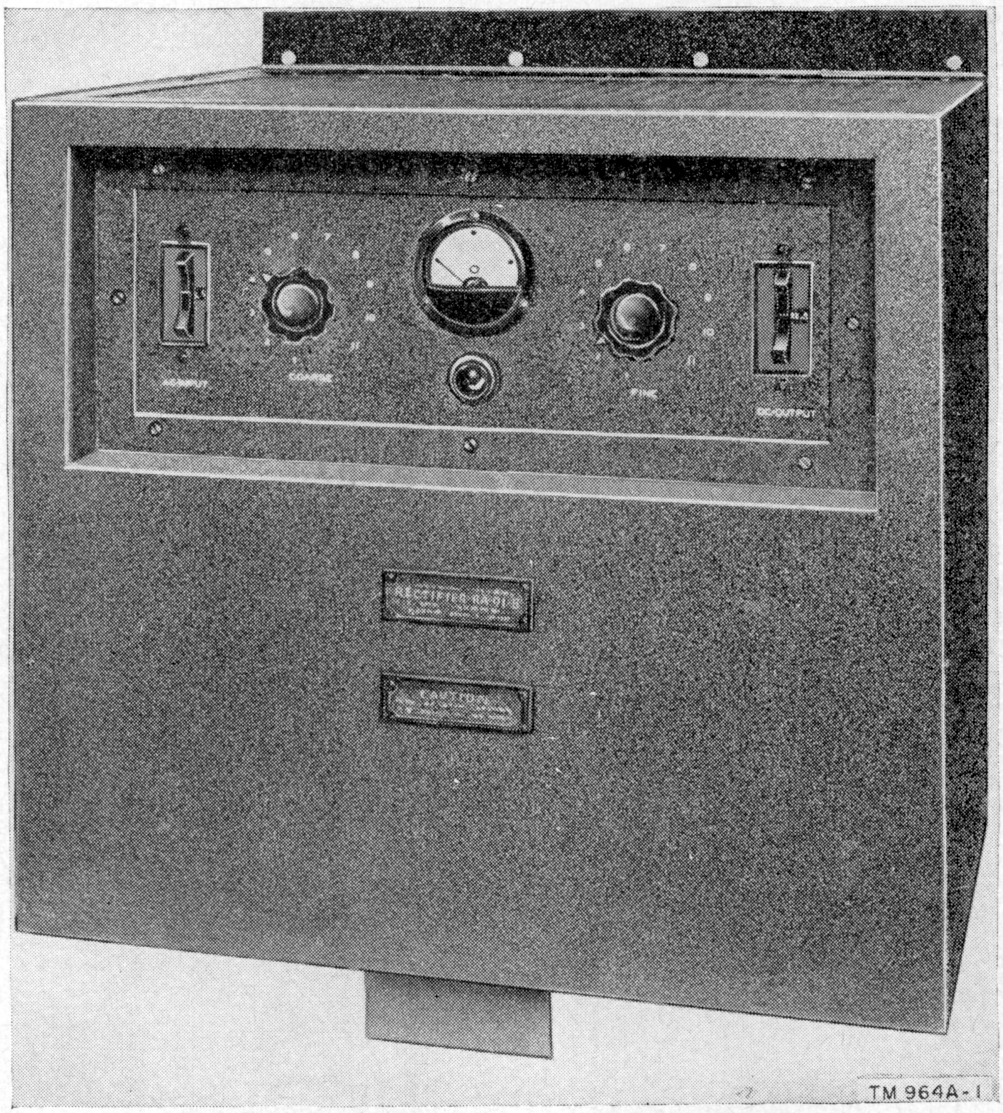

Figure 1. Rectifier RA–91–B.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this equipment is issued. They contain information on the operation and on the organizational and field maintenance of the equipment, as well as a discussion of the theory of operation. They apply only to Rectifier RA–91–B.

b. Appendix I contains a list of current references; appendix II contains an identification table of parts for Rectifier RA–91–B.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment:

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), NAV DEPT SERIAL 85P00 (Navy), and AFR 71–4 (Air Force).

b. DA AGO Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Description

a. Rectifier RA–91–B (fig. 1) is a full-wave, selenium-disk rectifier designed to deliver a d-c (direct-current) output suitable for charging lead-acid storage batteries from a 105- to 125- or 210- to 250-volt, 50- to 60-cycle, a-c (alternating-current) source.

b. The complete unit is inclosed in a metal case which is designed to be mounted in Panel BD–132. The over-all dimensions are 19½ inches wide, 12 inches deep, and 21¼ inches high; the weight is 100 pounds.

c. Rectifier RA–91–B consists of an assembly which includes a power transformer, two selenium rectifier stacks, and a filter reactor, all of which are mounted on a chassis (fig. 2). Two rotary d-c output control switches, an ammeter, an a-c circuit breaker, a d-c circuit breaker, and a pilot light are mounted on the front panel. A terminal board (fig. 4) provides for arranging the input circuit for 115- or 230-volt operation. A hinged cover on the rear of the cabinet, on which a circuit label is mounted, provides access to the terminal board.

d. Two two-conductor cords with plugs attached are provided: one for a-c input and the other for connection to the battery-charging circuit.

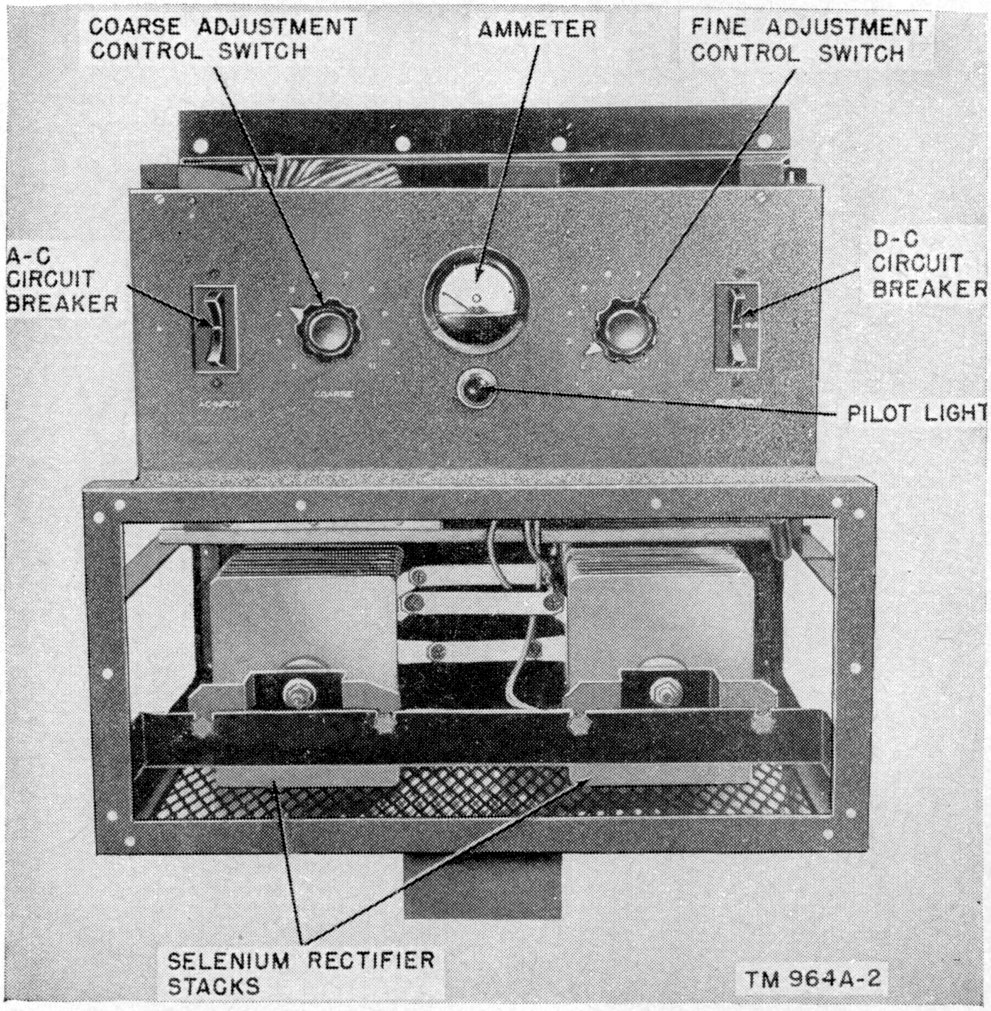

Figure 2. Rectifier RA–91–B, front view, with inclosing cover removed.

4. Purpose and Use

Rectifier RA–91–B is used for continuous or intermittent charging of the lead-acid storage batteries which are used with telephone central office sets. It is furnished as a component of Panel BD–132. The RA–91–B may be used also with a combination of Cabinet BE–75 and Panel BD–90 or similar equipment.

5. Technical Characteristics

Input	105 to 125 or 210 to 250 v ac, 50 to 60 cycles. (The line load capacity should be at least, 1,500 w.)
Output	Charging rate of from 2 to 12 amp into a 6- to 60-v battery (3 to 24 lead-acid cells).

6. Packaging Data

When packaged for export shipment, the rectifier is secured to a wooden skid and inclosed in a moisture-vaporproof barrier and a floating bag. The dimensions of the shipping container are as follows: 22 inches by 15 inches by 25 inches. The container weighs 190 pounds; the volume is 4.77 cubic feet. A corrugated fiberboard box containing the technical manual and the cords is attached to the mounting base which forms the bottom of the exterior wooden shipping container.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIAL

7. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 8.

a. GENERAL. The equipment may be shipped in oversea packing cases or in domestic packing cases. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation of the equipment. The instructions in *b* below apply to the equipment shipped in export packing cases, and the instructions in *c* below apply to equipment shipped in domestic packing cases.

Caution: Be careful when uncrating, unpacking, and handling this equipment; it may become damaged. If it becomes damaged, a complete overhaul may be required or the equipment may be rendered useless.

b. STEP-BY-STEP INSTRUCTIONS FOR UNCRATING AND UNPACKING EXPORT SHIPMENTS.

(1) Place the packing case as near as is convenient, to the operating position.
(2) Cut and fold back the metal straps.
(3) Remove the top with a tri-saw box opener, if available. (A standard nail puller may be used.)
(4) Lift the equipment from the shipping container.
(5) Cut the inner box and barrier seals carefully.
(6) Remove the equipment from the interior box and place it on a workbench or near its final location.
(7) Inspect the equipment for possible damage incurred during shipment. If the equipment is damaged or the shipping container is marked improperly, fill out and forward the applicable form (see par. 2).
(8) Check the contents of the packing case against the master packing slip.

c. UNPACKING DOMESTIC PACKING CASES. The instructions above apply also to unpacking domestic shipments. Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers from both export and domestic shipments. They can be used again when the equipment is repacked for storage and shipment.

8. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 7 for uncrating, unpacking, and checking the equipment.

b. Inspect and clean the equipment; check for loose internal connections.

c. Perform the installation and connection procedures given in paragraphs 9 and 10.

9. Setting Up Equipment

Rectifier RA–91–B usually is mounted in Panel BD–132. Refer to TM 11–2064 for the method of installing the rectifier in Panel BD–132. Under certain circumstances, it may be necessary to use Rectifier RA–91–B apart from Panel BD–132. Figure 3 shows the outline dimensional diagram of Rectifier RA–91–B. Note that mounting holes are drilled in the end plate to facilitate the mounting of the unit on any surface that is capable of supporting the RA–91–B.

Caution: Do not mount the rectifier in an area where acid splatter and fumes emanating from the battery vents will damage the unit. Allow a clearance of at least 4 inches above and below the rectifier when installing it.

10. Connections

a. CONNECTING TERMINAL BOARD STRAPS (fig. 4). Rectifier RA–91–B will operate from either a nominal 115- or 230-volt, 50- to 60-cycle, a-c supply if the straps on the terminal board are connected properly to arrange the input circuit. Open the hinged door on the back panel to obtain access to the terminal board, and proceed as follows:

(1) *Connections for 115-volt a-c supply.*
  (*a*) Remove the wingnuts holding the straps to the terminal board (fig. 4).
  (*b*) Place one strap between each pair of terminals marked 115V.
  (*c*) Replace and tighten the wingnuts.

(2) *Connections for 230-volt a-c supply.* Remove the wingnuts and place both straps together between the terminals marked 230V. Replace and tighten the wingnuts.

b. CONNECTING A-C AND D-C LEADS.

(1) *When installed in Panel BD-132.* Connect the a-c power cord into the a-c receptacle; connect the d-c battery-charging

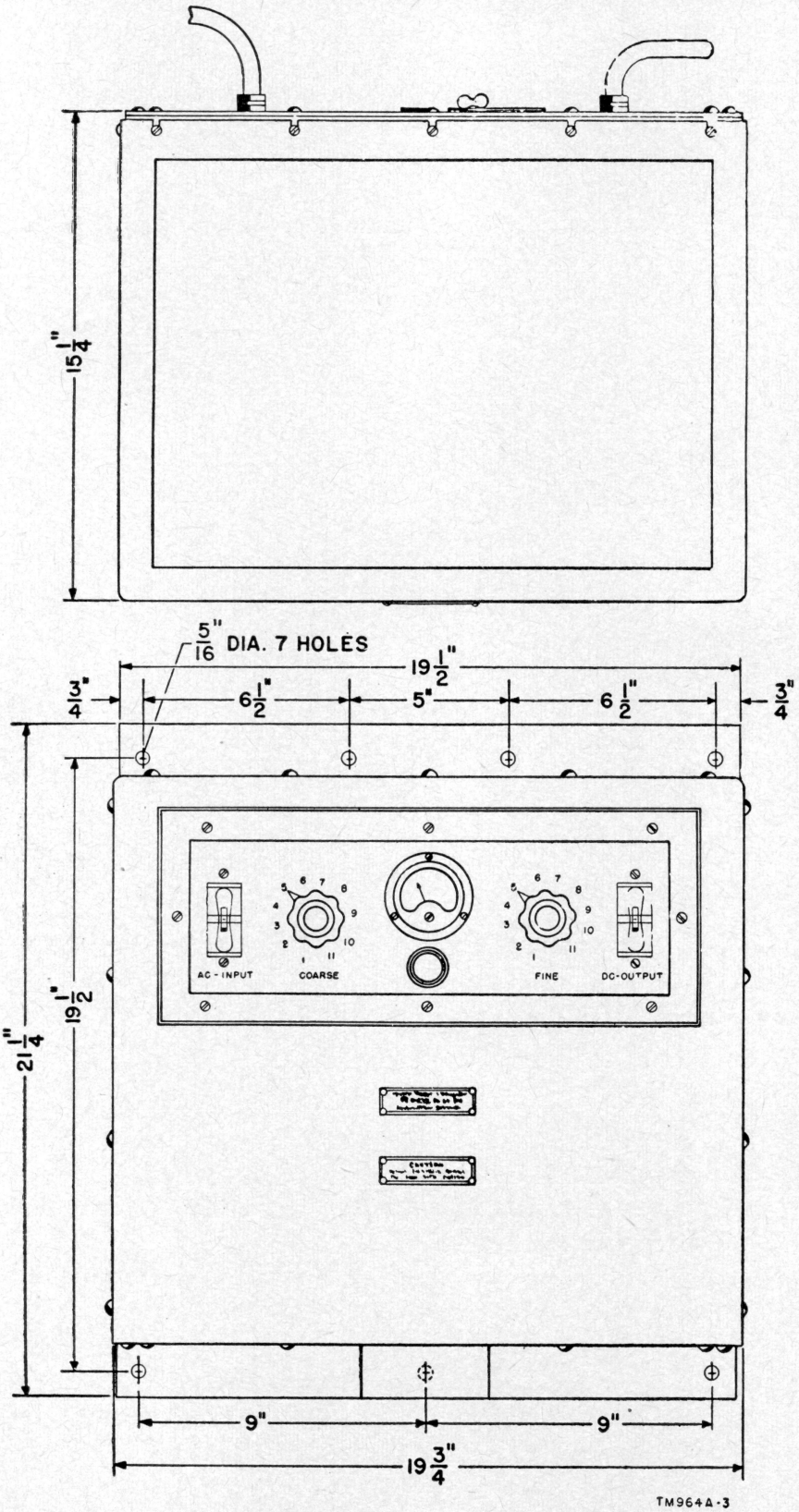

Figure 3. Rectifier RA–91–B, outline dimensional diagram.

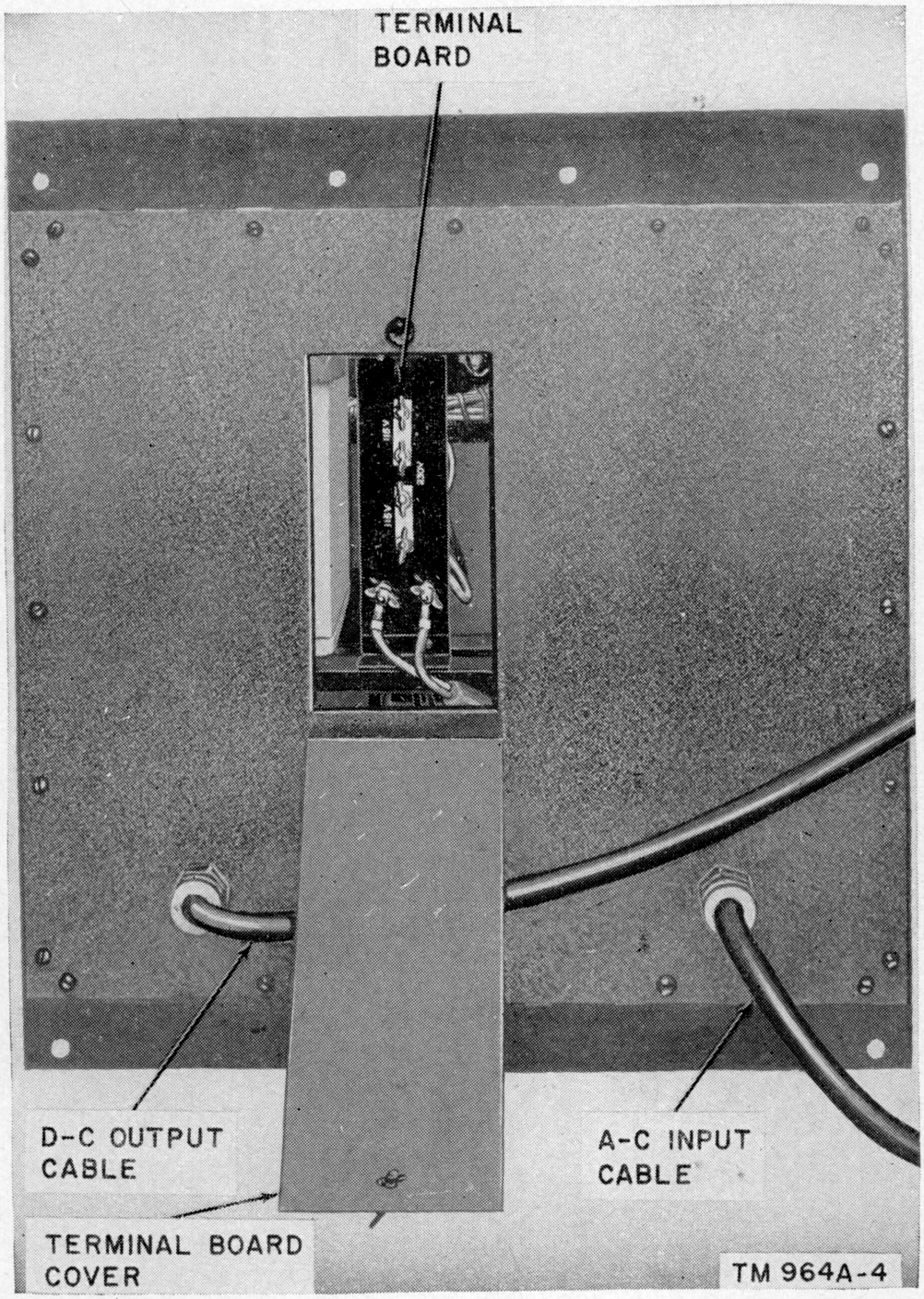

Figure 4. Rectifier RA–91–B, rear view, with terminal board cover open.

cord into the battery-charging receptacle. Check the connections for tightness. Poor connections cause arcing and sparking.

(2) *When used with Cabinet BE–75 and Panel BD–90 or similar equipment.* Plug the a-c power cord into the a-c outlet on Cabinet BE–75; plug the d-c battery-charging cord into the battery-charging circuit receptacle on Panel BD–90.

Caution: Always snap both circuit breakers off and turn each control switch to position 11 before connecting or disconnecting the battery-charging cord from the battery-charging circuit.

Section II. CONTROLS AND INSTRUMENTS

11. Circuit Breakers
(fig. 2)

a. Two magnetic-type circuit breakers are provided for control of the input and output circuits. They operate automatically if an overload develops in either circuit. The a-c INPUT circuit breaker automatically breaks the a-c line feeding the charger transformer if the input current exceeds 5 amperes. The d-c OUTPUT circuit breaker automatically breaks the d-c charging circuit if the charging current exceeds 20 amperes. The purpose of the circuit breakers is to prevent damage to the charger in the event of an overload. They also act as on-off switches for the equipment.

b. The a-c circuit breaker is located on the left of the panel; the d-c circuit breaker is located on the right of the panel. The circuit breakers are labeled a-c INPUT and d-c OUTPUT. Placing the a-c INPUT circuit breaker in the ON position sets the circuit breaker mechanism for tripping in the event of an overload and also completes the a-c line to the transformer primary which places the charger in operation. Placing the d-c OUTPUT circuit breaker in the ON position sets the circuit breaker mechanism for tripping and also completes the battery-charging circuit. Placing either circuit breaker in the OFF position opens the appropriate circuit and cuts off the a-c input or disconnects the load.

12. Control Switches
(fig. 2)

a. COARSE CONTROL SWITCH. This is an eleven-position rotary switch connected across half of the secondary of the transformer. The switch enables the operator to select the proper number of turns in the transformer secondary to adjust the current in the battery-charging circuit. The switch is used to obtain a rough adjustment of current. Use the COARSE control switch to obtain a rough adjustment of output current; use the FINE control switch (*b* below) to obtain an exact adjustment of output current. Switch position 1 taps the fewest number of turns in the transformer secondary and provides the maximum charging current; switch position 11 taps the largest number of turns and provides the minimum charging current.

b. FINE CONTROL SWITCH. This switch is identical in operation to the COARSE control switch. It is used to provide finer control of

the charging current than it is possible to provide with the COARSE control alone.

13. Ammeter
(fig. 2)

The ammeter indicates the battery-charging current in amperes. All battery-charging current flows through the ammeter which is connected in series with the common return circuit of the full-wave rectification circuit. The ammeter range is 0 to 15 amperes; as the d-c output is fused at 20 amperes, there is little danger of meter burnout.

14 Pilot Light
(fig. 2)

The pilot light is connected across the a-c input to the transformer on the a-c INPUT circuit breaker side of the circuit. It is energized when the circuit breaker closes the circuit to the transformer primary. The lamp glows and indicates that current is flowing in the primary circuit of the charger. This does not necessarily mean that the charger is operating; the lamp may glow even if no load is placed upon the d-c OUTPUT circuit. Do not assume that the glowing of the lamp means that the rectifier is delivering current to the battery under charge. Check the ammeter indication to determine whether current is flowing through the battery.

Section III. OPERATION UNDER USUAL CONDITIONS

15. Preliminary Procedures

a. Place each circuit breaker in the OFF position.
b. Turn each control switch to position 11.
c. Check all external connections carefully.
d. Be certain that the batteries are connected correctly.

(Refer to TM 11–2064 and TM 9–2857 for the proper method of connecting batteries for charging.)

16. Starting

a. Place each circuit breaker in the ON position. (The pilot light will glow if the primary circuit is continuous.)

b. Turn the coarse adjustment control switch counterclockwise from position 11. The ammeter should indicate a low charging rate. If the ammeter does not register any current, make sure that the d-c circuit breaker is closed. The ammeter should register a flow of current if the secondary circuit (par. 28*b*) is continuous.

c. Adjust the charging current to the desired rate (refer to TM 9–2857) by operating the FINE control switch counterclockwise from position 11. *The charging rate must never exceed 12 amperes.*

17. Continuous Charging with Rectifier RA–91–B

The purpose of continuous charging (trickle charging) is to furnish a steady charging current 24 hours a day, which will be adequate to replace the drain on the batteries used in telephone central office sets.

a. CHARGING RATE. Refer to TM 9–2857 for complete information on approved charging methods and correct charging rates for lead-acid storage batteries.

b. CHECKING CONDITION OF CHARGE. The methods listed below may be used to determine whether or not the batteries in the system are fully charged.

(1) Use a hydrometer to measure the specific gravity of the electrolyte. Be certain that the hydrometer is equipped with a thermometer; if this is not the case, measure the temperature of the electrolyte with a thermometer at the same time the specific gravity reading is made. Refer to TM 9–2857 and TM 11–430 for correct values of specific gravity.

(2) Connect a d-c voltmeter momentarily across the battery terminals. The reading across each *cell* should be between 2.3 to 2.5 volts when the battery is fully charged. A reading of 1.75 volts indicates that the battery is completely discharged.

c. IMPROPER CHARGING. If the batteries do not become fully charged after a reasonable period of time (24 hours), check the battery for dead or defective cells (see TM 9–2857). If the battery is gassing and bubbling violently and the temperature of the liquid in the cells rises, the charging rate is too high. Reduce the charging rate accordingly.

d. DAILY BATTERY CHECK. Check the condition of each battery in the system at least once each day to be certain that it is receiving the proper charge and that the liquid level in each cell is correct. Do not let the battery run down because the charging rate is too low, and do not ruin the batteries by overcharging.

18. Intermittent (Rapid) Charging with Rectifier RA–91–B

Rectifier RA–91–B may be used for intermittent (rapid) charging when it is necessary to charge batteries as quickly as possible. *Refer to TM 9–2857 and TM 11–430 for the procedure to be followed.*

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

19. General

Rectifier RA–91–B may be operated under unusual climatic conditions without injury to the equipment. If, however, operation under unusual conditions is to be maintained for long periods, certain precautions must be taken. Refer to paragraphs 20 through 22 for information covering operation under unusual conditions.

20. Operation in Arctic Climates

Condensation will form inside the rectifier if the unit is exposed to alternate low and high temperatures. Maintain the temperature in the room or shelter which houses the rectifier at as constant a level as possible. The internal resistance of the batteries being charged increases with a decrease in temperature. Refer to TB SIG 66 for precautions necessary under arctic conditions.

21. Operation in Desert Climates

Take precautions against the entry of sand and dust into the equipment. Improvise a suitable cover and place it completely around the rectifier whenever it is taken out of operation. Where feasible, run the rectifier at a lower rate to reduce the operating temperature. Refer to TB SIG 75 for additional precautions for desert operation.

22. Operation in Tropical Climates

Although the rectifier is a low-voltage, high-current device, the presence of moisture and mold on the parts may impair the operation of the equipment. The varnish applied to the parts during the moistureproofing and fungiproofing treatments will protect against moisture and mold attack. Damage to the varnish film must be repaired as quickly as possible. As soon as the rectifier is shut down for the day, cover it thoroughly so that no moisture will be drawn into the equipment when the rectifier is taken out of service. Protect the equipment against sudden tropical downpours. Refer to TB SIG 13 and TB SIG 72 for additional tropical operational information.

CHAPTER 3
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

23. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that break-downs and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring.

24. Preventive Maintenance Tools and Materials

No special tools and materials are supplied with Rectifier RA–91–B. Tools and materials required for preventive maintenance are included in Tool Equipment TE–44 which is supplied with the telephone central office equipment of which the rectifier is a part.

25. Preventive Maintenance Services

a. DAILY SERVICES.
- (1) Remove dirt from the rectifier panel with a lint-free cloth. Clean the ammeter glass.
- (2) Zero the ammeter if necessary.
- (3) Check the rotary switch knobs for secure fit on the shafts. Tighten if necessary.

b. MONTHLY SERVICES.
- (1) Perform the daily services.
- (2) Use a blast of compressed air to blow dust from the interior of the rectifier.
- (3) Check all binding posts and terminals for loose connections. *Do not use a sharp tool; the varnish film must remain intact.*
- (4) Check and tighten, if necessary, all mounting nuts, studs, and brackets.

Section II. PRESERVATION

26. Weatherproofing

a. GENERAL. Signal Corps equipment, when operated under severe

climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growths, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. TROPICAL MAINTENANCE. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 and TB SIG 72.

c. WINTER MAINTENANCE. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66.

d. DESERT MAINTENANCE. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained fully in TB SIG 75.

e. LUBRICATION. No special precautions are necessary as only a trace of lubricant is used on the rotary switches.

27. Rustproofing and Painting

a. When the finish on the exterior of the equipment has been scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with Solvent, dry-cleaning (SD). In severe cases it may be necessary to use solvent (SD) to loosen the rust and to use sandpaper to complete the preparation for painting. The paint used will be authorized and consistent with existing regulations.

c. If the individual panel markings are worn, re-mark the panel.

CHAPTER 4
THEORY

28. General
(fig. 5)

The rectifier consists of four basic parts; the transformer (T1), the circuit breakers (K1 and K2), the selenium rectifier stacks (CR1 and CR2), and the filter reactor (L1).

a. TRANSFORMER. The function of the transformer is to provide the voltage and current required for the rectifier stacks to produce a d-c output for the charging circuit. The transformer also permits control of the voltage and current in the battery-charging circuit.

(1) *Primary circuit.* The primary circuit of the transformer consists of two 115-volt windings which may be connected for operation either from a 115- or a 230-volt a-c source (par. 10*a*).

(2) *Secondary circuit.* The secondary circuit of the transformer is a single winding with 11 coarse adjustment taps on one end and 11 fine adjustment taps on the other end for control of the voltage and current delivered to the rectifier stacks.

b. CIRCUIT BREAKERS. The circuit breakers close and open the a-c supply circuit and the d-c input circuits, effectively turning the RA–91–B on and off. They provide protection against overloads and short circuits.

c. RECTIFIER STACKS. Rectifier RA–91–B has 2 metallic selenium stacks, each containing 20 selenium plates mounted on 1 bolt. Each stack has three terminals (fig. 6). The outer taps are for the a-c input; the center taps are for the d-c output. The two stacks are connected in parallel. The function of the rectifier is to convert ac into pulsating dc.

d. FILTER REACTOR. The filter reactor is used to filter the pulsating d-c output, thereby reducing noise in the telephone circuit into which the batteries being charged are connected. The filter reactor and the ammeter are connected in series with the battery-charging circuit of the panel to which the RA–91–B is connected.

29. Circuit Analysis
(fig. 5)

a. PRIMARY CIRCUIT.

(1) *115-volt operation.* When the rectifier is arranged for 115-volt operation, the primary circuit consists of the two primary

windings of the transformer connected in parallel. One branch extends from plug P1 through circuit breaker K1 to binding post 4, through the PRI No. 1 winding, to binding post 3, to the 115V terminal, through the strap to plug P1. The other branch extends from plug P1, through K1, to the 115V terminal, through the strap, to binding post 2, through the PRI No. 2 winding, to binding post 1, to the 115V terminal, to plug P1.

(2) *230-volt operation.* When the rectifier is arranged for 230-volt operation, the primary circuit consists of the two primary windings of the transformer connected in series. The circuit extends from plug P1, through K1, through PRI No. 1 winding, to the 230V terminal, through the strap to the other 230V terminal, through PRI No. 2 winding, to the 115V terminal, to plug P1.

(3) *Pilot light.* Regardless of the input voltage, the pilot light is always across the a-c input circuit.

b. SECONDARY CIRCUIT. With the application of the alternating current across the primary windings, current is induced into the secondary windings. The secondary circuit extends from the coarse taps of the secondary winding through half of the rectifier circuit, through the filter reactor, through the battery-charging circuit, through circuit breaker K2, through the ammeter, through half of the rectifier circuit, to the fine taps of the secondary winding.

c. RECTIFIER ACTION. The purpose of the rectifier is to convert the alternating current appearing across the secondary of the transformer into pulsating direct current in order to charge the batteries. The rectification action is as follows: In the first half of the cycle, current flows from COARSE tap 9, through the rectifier stack to the + terminal, through the filter reactor, through the battery-charging circuit, through K2, through the ammeter to the — terminal of the rectifier, and through the rectifier stack to COARSE tap 9; in the second half of the cycle, current flows from FINE tap 9, through the rectifier stack to the + terminal, through the filter reactor, through the battery-charging circuit, through K2, through the ammeter to the — terminal of the rectifier, and through the rectifier stack to FINE tap 9. Note that the current always flows through the battery-charging circuit in the same direction, regardless of the direction of current flow through the secondary winding.

Note. FINE and COARSE taps 9 have been chosen as a typical example. The circuit action is the same regardless of switch setting.

d. OVERLOAD-CONTROL CIRCUIT (par. 11). If the values of current in either the input or output circuits exceed the operating limits of the circuit breakers, the circuit breaker coils develop magnetic fields strong enough to energize a solenoid. Operation of the solenoid opens the appropriate circuit. A manual resetting mechanism closes the circuit breaker and the appropriate circuit.

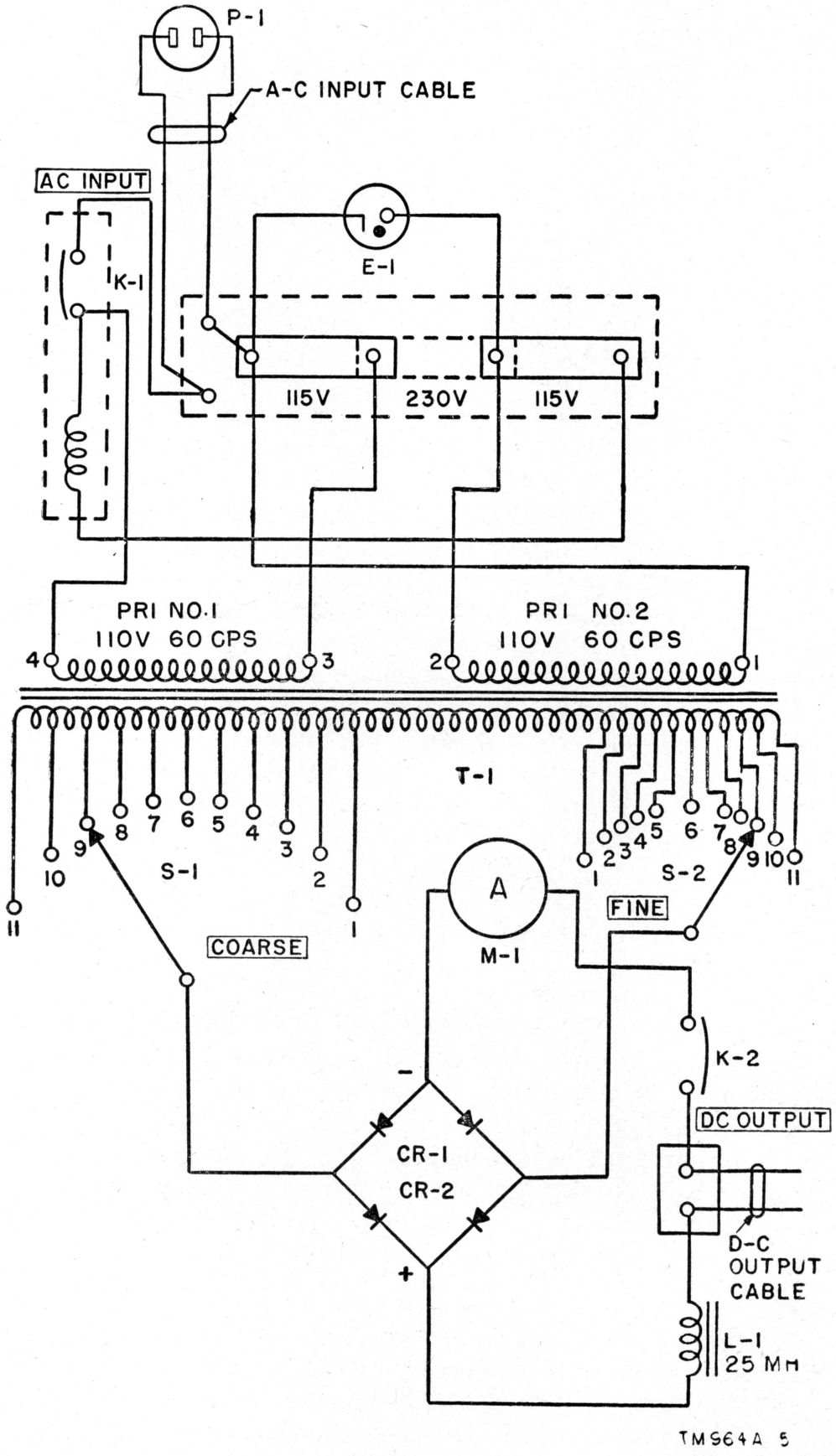

Figure 5. Rectifier RA–91–B, schematic diagram.

CHAPTER 5
FIELD MAINTENANCE INSTRUCTIONS

Section I. GENERAL

30. Field Maintenance Services

a. PURPOSE. The repair instructions that follow are intended for use by field maintenance personnel trained and equipped to handle complex repairs that require special equipment not generally available to organizational maintenance personnel.

b. SCOPE. The scope of repairs that may be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the assigned personnel. However, most field maintenance is limited to determination and replacement of defective parts.

31. Tool and Test Equipment

The tool and test equipment required for the maintenance of Rectifier RA–91–B are included in Tool Equipment TE–44, which is supplied with the telephone central office equipment of which the rectifier is a part. In addition, a 6-volt lamp wired in series with a 6-volt battery (preferably a storage battery) and brought out in two test prods may be used to check for continuity in the individual circuit elements.

Section II. TROUBLE LOCATION

32. General

If the rectifier fails to operate satisfactorily, check all possible causes which are listed in the trouble-shooting chart (par. 33). Many troubles are caused by simple factors, such as loose connections, corrosion, opens, shorts, etc. Avoid elaborate testing procedures until all of the simple probable causes have been eliminated.

33. Trouble Shooting Chart

Trouble	Probable cause	Remedy
Pilot light glows, ammeter does not show current.	Operated circuit breaker K2.	Restore circuit breaker.
	Defective transformer windings.	Replace transformer.
	Defective meter	Replace meter.
	Open in battery-charging circuit.	Check all connections in battery-charging circuit.
	Loose or open internal wiring.	Check all connections and test all wiring for continuity.
Pilot light does not glow, ammeter shows current.	Defective lamp	Replace lamp.
	Loose connections in lamp circuit.	Check all connections.
	Open in lamp circuit	Replace wiring.
A-C INPUT circuit breaker snaps off and will not stay on.	Short in primary circuit	Check circuit; replace wiring or defective parts.
	Improper connections at terminal boards.	Check connections (par. 10).
D-C OUTPUT circuit breaker snaps off and will not stay on.	Improper setting of control switches.	Check setting of control switches; they may be set to give a charging rate higher than 20 amperes.
	Short in rectifier stacks	Replace rectifier.
	Short in battery-charging circuit.	Check circuit.
Unable to get proper output.	Improper line voltage	Check input voltage.
	Defective transformer	Replace transformer.
	Defective rectifier	Replace rectifier.

34. Testing Procedures

(fig. 6)

Note. The colors on the wiring diagram refer to the color-coding of the wiring. The a-c circuit (primary circuit and secondary circuit up to rectifier stacks) is color-coded yellow; the negative d-c circuit is color-coded black; the positive d-c circuit is color-coded red.

a. CONTINUITY TESTING. Refer to figure 5 for a wiring diagram of the equipment. To test any circuit element for continuity, connect the volt-ohm-milliammeter of Tool Equipment TE–44 or the test lamp and battery to the proper terminals. If continuity is present, the ohmmeter scale will indicate a definite value of resistance and the lamp will glow. If a short is present, the ohmmeter indication will be very

low or the lamp will glow very faintly. *The rectifier stacks cannot be tested with this equipment.* If the trouble indicates that the probable cause is located in the rectifier stacks, test all of the circuit, preceding and following the rectifier, for continuity. If continuity exists, the trouble lies in the rectifier stacks.

b. TESTING TRANSFORMER. Check the open-circuit voltages of the transformer secondary windings with the volt-ohm-milliammeter, as follows:

(1) *Voltages at FINE taps.* Connect one meter lead to tap No. 1 on switch S1 (fig. 6); connect the other lead to the tap being tested. The table below shows the correct meter readings at normal line voltages.

(2) *Voltages at COARSE taps.* Connect one meter lead to tap No. 1 on switch S2 (fig. 6); connect the other lead to the tap being tested. The table below shows the correct meter readings at normal line voltages.

COARSE adjustment taps	A-c volts measured from FINE tap No. 1	FINE adjustment taps	A-c volts measured from COARSE tap No. 11
11	118.0	11	129.5
10	107.0	10	128.0
9	95.5	9	127.0
8	84.5	8	126.0
7	73.0	7	125.0
6	61.0	6	124.0
5	50.5	5	123.0
4	39.0	4	122.0
3	28.0	3	120.5
2	16.5	2	119.5
1	5.0	1	118.0

c. TESTING FILTER REACTOR.

(1) *Testing for short.* Connect the filter reactor directly across a 115-volt, 60-cycle, a-c line. If the unit heats excessively, the filter is shorted.

(2) *Testing for open.* Connect the filter in series with an a-c ammeter directly across a 115-volt, 60-cycle, a-c line. The current reading should lie between 2.8 and 3.1 amperes. No current reading indicates an open circuit.

d. TESTING RECTIFIER STACKS. There are no simple electrical tests that will reveal the existence of defects in the rectifier stacks. If the stack is defective, the temperature of the stacks will be very high, the counter electrode coating may be pitted, blistered, or melted away from the disk, or the varnish coating may be discolored or burnt. Do not attempt to repair the rectifier stack; replace it immediately.

e. CHECKING ROTARY SWITCHES. If the ammeter indication is erratic, check the rotary switch for poor contact. With the rectifier in operation, apply pressure to the rotary switch knob by pushing, pulling, and twisting. Note the action of the ammeter needle. Any ammeter fluctuation resulting from this action may be attributed to the failure of the rotary switch to make positive contact. Replace the switch. A slight amount of fluctuation is not serious and may be disregarded.

f. CHECKING CIRCUIT BREAKERS. If difficulty is encountered with the trip mechanism inside the circuit breakers, replace the defective part. *Do not attempt to repair the circuit breaker.* If a circuit breaker is suspected of not opening the circuit on overload, replace the part with one of known good quality.

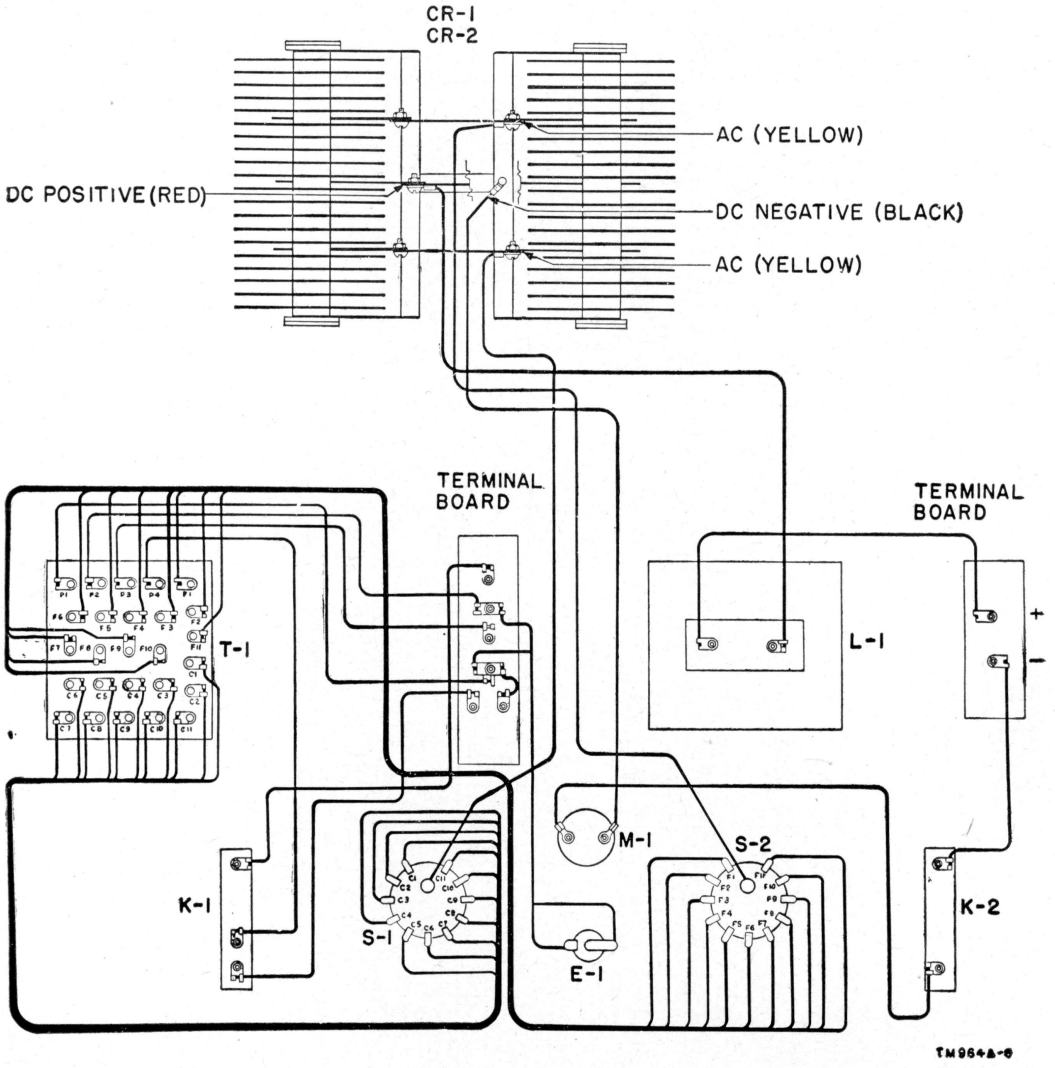

Figure 6. Rectifier RA–91–B, wiring diagram.

Section III. DISASSEMBLY, ASSEMBLY, AND FINAL TESTING

35. Replacement of Parts

(figs. 7 and 8)

The parts of Rectifier RA–91–B are directly accessible when the housing is removed. For trouble shooting, it is usually unnecessary to remove any of the parts. When it is necessary to replace parts, consult the wiring diagram (fig. 6) to be certain that the wiring is replaced properly. Tag all affected leads for identification when removing or installing new parts. The removal and replacement of all of the parts, with the exceptions listed in *a* and *b* below, do not require any additional precautions.

a. TRANSFORMER OR FILTER REACTOR. Take off the nuts underneath the angle irons which support the apparatus.

b. RECTIFIER STACKS. Remove them with the brackets attached. Then remove the brackets from the units. Adjust the nuts on the studs in order not to put undue pressure on the brackets.

36. Final Testing

a. GENERAL. When extensive repair work has been performed on the rectifier, test the unit as described below:

b. MECHANICAL TEST. After the rectifier is reassembled, make a complete check of the terminals, mountings, connections, parts placement, and other mechanical points. See that the moistureproofing and fungiproofing varnish has not been damaged. Check the circuit breaker operation for firm make or break operation.

c. ELECTRICAL TEST.

(1) *Power source.* For final testing, a power source of 105- to 125-volt, or 210- to 230-volt, 50- to 60-cycle ac with a load capacity of 1,500 watts is required.

(2) *Transformer.* Test the voltages at the FINE and COARSE taps as described in paragraph 34*b*.

(3) *Filter reactor.* Test the filter reactor as described in paragraph 34*c*.

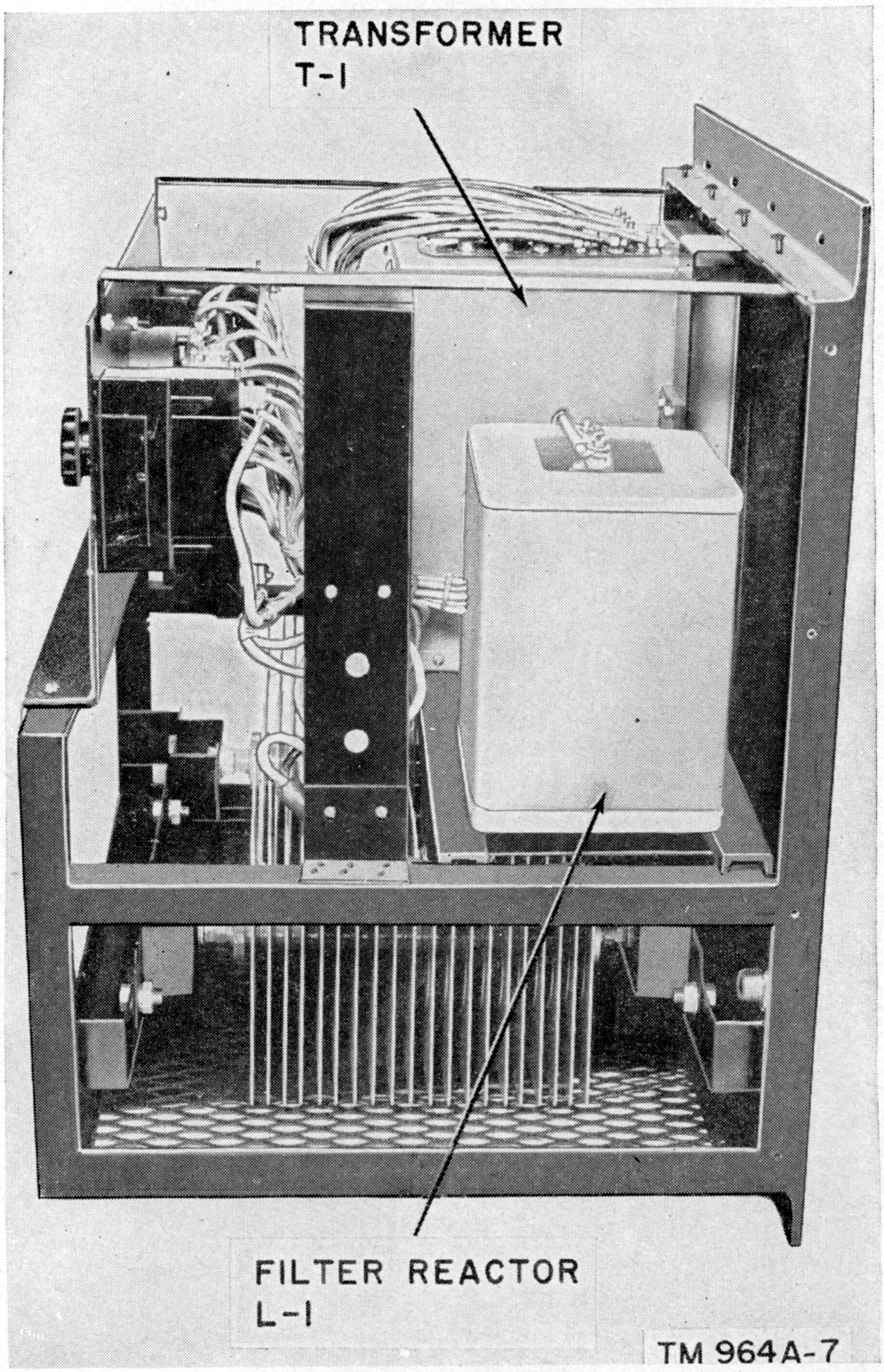

Figure 7. Rectifier RA–91–B, right side view, cover removed.

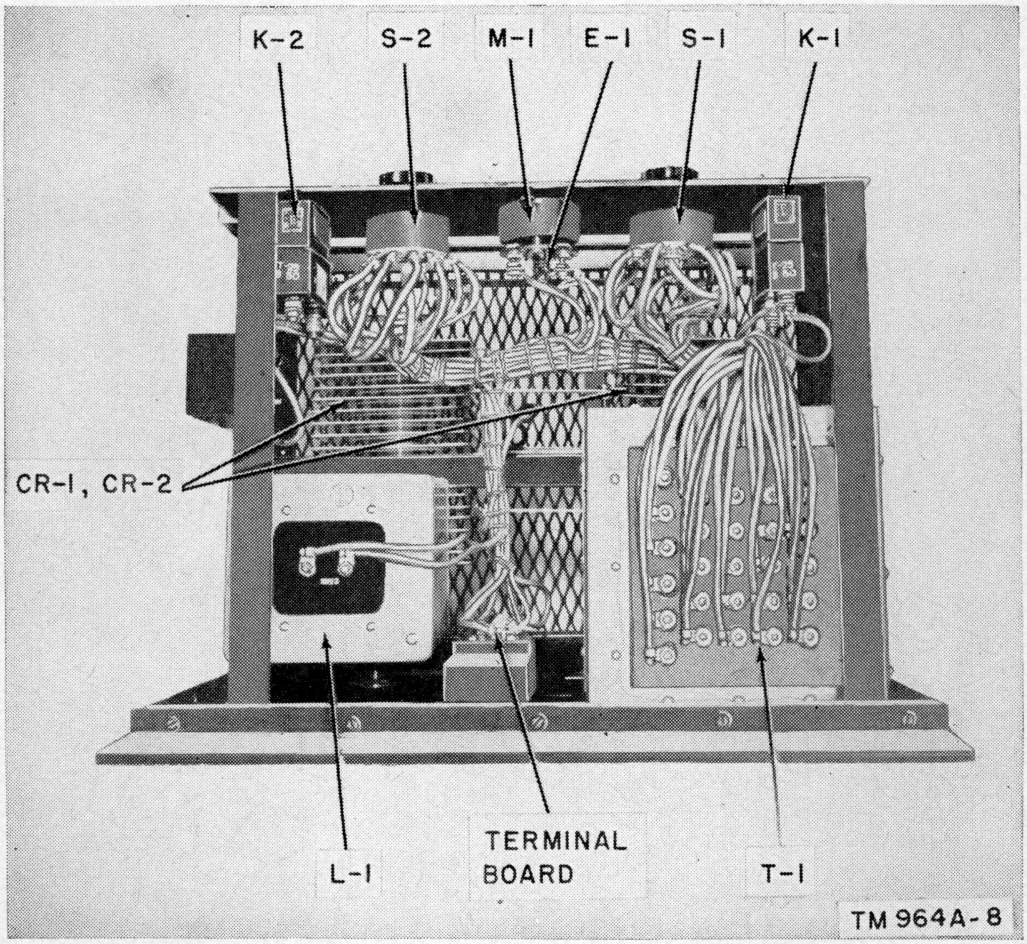

Figure 8. Rectifier RA–91–B, top view, cover removed.

CHAPTER 6
SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

37. Packing Equipment for Shipment

a. Prepare a wooden base slightly larger than the dimensions of the base of Rectifier RA–91–B.

b. Disconnect the input and output cords. Clean the unit and place it on the wooden base.

c. Attach the equipment to the base with metal straps or other means. Place desiccant around the rectifier base and wrap the entire unit with flexible corrugated paper.

d. Place the technical manual and cords in a close-fitting cardboard container.

e. Inclose both the cardboard container and the corrugated-paper-wrapped unit with a moisture-vaporproof barrier and place them inside another corrugated-paper wrapping. Inclose this in a waterproof liner.

f. Use the wooden base as a foundation; build up the sides and the top of a wooden inclosure and nail securely.

g. Bind the wooden box with metal straps to protect the equipment against rough handling.

38. Packing for Limited Storage

a. Clean and dry the equipment thoroughly.

b. Place the equipment in a moisture-vaporproof barrier with a quantity of desiccant placed around the base. Heat-seal the barrier.

c. Place the inclosed unit in a cool, dry, place.

Section II. DEMOLITION TO PREVENT ENEMY USE

39. Methods of Demolition

a. Smash. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

b. Cut. Use axes, handaxes, and machetes.

c. Burn. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

d. Explode. Use firearms, grenades, and TNT.

e. Dispose. Bury in slit trenches, fox holes, and other holes. Throw in streams. Scatter.

f. Other. Use anything immediately available for the destruction of this equipment.

40. Destruction of Components

When ordered by your commander, destroy all equipment to prevent its being used or salvaged by the enemy.

a. Smash (par. 39*a*) the transformer, adjustment switches, filter reactor, ammeter, rectifier stacks, circuit breakers, etc.

b. Cut (par. 39*b*) all wiring and the input and output cables.

c. Burn (par. 39*c*) technical manual, circuit label, etc.

d. Bury or *scatter* (par. 39*e*) all remaining parts of the rectifier.

e. Destroy Everything.

APPENDIX I
REFERENCES

Note. For availability of items listed, check SR 310–20–3 for field manuals and JANAP's. Check SR 310–20–4 for technical manuals, technical bulletins, and supply bulletins.

1. Technical Manuals for Equipment Associated with Rectifier RA–91–B

TM 11–335	Telephone Central Office Set TC–1.
TM 11–338	Telephone Central Office Set TC–10.
TM 11–340	Telephone Central Office Set TC–2.
TM 11–430	Batteries for Signal Communication. Except those pertaining to Aircraft.
TM 11–2064	Panel BD–132.

2. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.

3. Packaging and Packing Information

a. JOINT ARMY-NAVY PACKAGING SPECIFICATIONS.

JAN–D–169	Dessicants, (activated).
JAN–P–106A	Packaging and packing for overseas shipment—Boxes; wood, nailed.
JAN–P–108	Packaging and packing for overseas shipment—Boxes, fiberboard (V-board and W-board), exterior and interior.
JAN–P–116	Packaging and packing for overseas shipment—Preservation, methods of.
JAN–P–125	Packaging and packing for overseas shipment—Barrier-materials, waterproof, flexible.

JAN–P–127	Packaging and packing for overseas shipment—tape, adhesive, pressure-sensitive, water-resistant.
JAN–P–131	Packaging and packing for overseas shipment—Barrier-material, moisture-vaporproof, flexible.
JAN–P–133	Packaging and packing for overseas shipment—Boxes, set-up, paperboard.
JAN–P–140	Packaging and packing for overseas shipment—Adhesive, water-resistant, case liner.

b. U. S. ARMY SPECIFICATIONS.

100–2E	Marking shipments by contractors (and Signal Corps supplement thereto).
100–14A	Army-Navy General Specification for packaging and packing for overseas shipment.

c. SIGNAL CORPS INSTRUCTIONS.

720–7	Standard pack.
726–15	Interior marking.

4. Decontamination

TM 3–220	Decontamination.

5. Demolition

FM 5–25	Explosives and Demolitions.

6. Other Publications

SB 11–47	Preparation and Submission of Requisitions for Signal Corps Supplies.
SR 310–20–3	Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications).
SR 310–20–4	Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of

	Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.
SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247).
SR 745–45–5 NAV DEPT SERIAL 85P00 AFR 71–4	Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army), SandA–70–6 (Navy), and AF–MC–U2 (Air Force)).
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 123	Preventive Maintenance Practices for Ground Signal Equipment.
TM 11–490	Electrical Fundamentals.
TM 9–2857	Storage Batteries, Lead-Acid Type.

APPENDIX II
IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, T/A, SIG 7&8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 8–RA–91. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECTIFIER RA–91–B: selenium type; input 110 v, 60 cyc; output 6 to 60 v dc, 12 amp max; sq ventilated steel case (includes 2 connection cable assemblies).		3H4669–91
A-C INPUT CABLE, D-C OUTPUT CABLE	CABLE, power (wire): 2 #14 AWG stranded cond; rubber insulated; RC.	Input and output cords	1B814.31
K2	CIRCUIT BREAKER: magnetic; dc	Opens d-c circuit and protects d-c circuit against overload.	3H900–20–12
K1	CIRCUIT BREAKER: magnetic; ac	Opens a-c circuit and protects a-c circuit against overload.	3H900–6–2
FINE, COARSE	KNOB, round: black; bakelite	Knob for FINE and COARSE adjustment rotary switches.	2Z5788–12
E1	LAMP, glow: 105 to 125 v	Part of pilot light assembly	2Z5889–13
E1	LAMPHOLDER ASSEMBLY: pilot light	Pilot light assembly	2Z5884–49
M1	METER, ammeter: dc	Measures d-c output current	3F1050–50
L1	REACTOR: filter choke	Filters d-c output	3C575X–9
CR1, CR2	RECTIFIER, metallic: selenium	Converts ac to dc	3H4858–24
COARSE, FINE	SWITCH, rotary	Controls output current	3Z9825–64.14
	TERMINAL, lug	Wire interconnection	3Z12050–4
T1	TRANSFORMER	Controls voltage applied to rectifier	2Z9606–75

INDEX

	Paragraph	Page
Ac INPUT circuit breaker, description	11*b*	8
Ac INPUT lead, connections	10	5
Ammeter, description	13	9
Arctic climates, operation	20	11
Battery check during charging, daily	17*d*	10
Cabinet BE–75, connections	10*b*(2)	7
Charging with Rectifier RA–91–B:		
Charging rate	17*a*	10
Continuous charging	17	10
Intermittent charging	18	10
Circuit analysis	29	14
Circuit breakers:		
Description	11	8
Function	28*b*	14
COARSE adjustment switch, description and function	12*a*	8
Condition of charge, checking	17*b*	10
Connections	10	5
Continuity testing	34*a*	18
Continuous charging with Rectifier RA–91–B	17	10
Controls	11, 12, 14	8, 9
Control switches, description and function:		
COARSE adjustment switch	12*a*	8
FINE adjustment switch	12*b*	8
Dc INPUT circuit breaker, description	11	8
Dc INPUT lead, connections	10*b*	5
Demolition to prevent enemy use	39, 40	24, 25
Desert climates:		
Maintenance	26*d*	13
Operation	21	11
Dimensions, Rectifier RA–91–B:		
Packaged	6	3
Unpacked	3*b*	1
Domestic packing cases, unpacking	7*c*	4
Electrical test, final testing	36*c*	21
Export shipments, step-by-step instructions for uncrating and unpacking.	7*b*	4
Field maintenance services:		
Purpose	30*a*	17
Scope	30*b*	17
Tool and test equipment	31	17
Filter reactor:		
Function	28*d*	14
Testing	34*c*	19
Final testing	36	21
FINE adjustment switch, description and function	12*b*	8
Forms and records	2	1

	Paragraph	Page
Identification table of parts	App. II	29
Improper charging	17*c*	10
Instruments	13	9
Intermittent charging with Rectifier RA–91–B	18	10
Limited storage	38	24
Lubrication under unusual conditions	26*e*	13
Mechanical test (final testing)	36*b*	21
Operation:		
Preliminary procedures	15	9
Under unusual conditions	19–22	11
Under usual conditions	15–18	9
Overload-control circuit, theory	29*d*	15
Packaging data	6	3
Packaging of equipment:		
Limited storage	38	24
Shipment	37	24
Painting	27	13
Panel BD–90, connections	10*b*(2)	7
Panel BD–132, operation with	4, 9, 10	2, 5
Parts, identification table	App. II	29
Pilot light, description	14	9
Preventive maintenance:		
Definition	23	12
Services	25	12
Tools and materials	24	12
Primary circuit:		
Description	28*a*(1)	14
Theory	29*a*	14
Purpose and use, Rectifier RA–91–B	4	2
Reconditioned equipment, service on receipt	8	5
Rectifier RA–91–B:		
Connections	10	5
Controls	11, 12, 14	8, 9
Demolition	39, 40	24, 25
Description	3	1
Dimensions	3*b*	1
Disassembly, assembly, and final testing	35, 36	21
Field maintenance	30–34	17
Instruments	13	9
Operation:		
Under unusual conditions	19–22	11
Under usual conditions	15–18	9
Packaging data	6	3
Preventive maintenance services	23–25	12
Purpose and use	4	2
Setting up	9	5
Shipment and limited storage	37, 38	24
Technical characteristics	5	3
Theory	28, 29	14
Uncrating, unpacking, and checking new equipment	7	4
Weatherproofing	26, 27	12, 13

	Paragraph	Page
Rectifier stacks:		
Function	28*c*	14
Replacement	35*b*	21
Theory	29*c*	15
References	App. I	26
Replacement of parts	35	21
Rotary switches, testing	34*e*	20
Rustproofing	27	13
Scope	1	1
Secondary circuit:		
Description	28*a*(2)	14
Theory	29*b*	15
Setting up of equipment	9	5
Shipment, packing equipment for	37	24
Starting procedures	16	9
Technical characteristics	5	3
Terminal board connections:		
115-volt, a-c supply	10*a*(1)	5
230-volt, a-c supply	10*a*(2)	5
Testing, final	36	21
Testing procedures	34	18
Tool and test equipment:		
Field maintenance	31	17
Preventive maintenance	24	12
Transformer:		
Function	28*a*	14
Replacement	35*a*	21
Testing	34*b*	19
Tropical climates:		
Maintenance	26*b*	13
Operation	22	11
Trouble location	32, 33	17, 18
Trouble-shooting chart	33	18
Uncrating, unpacking, and checking new equipment	7	4
Used equipment, service upon receipt	8	5
Weatherproofing	26	12
Winter maintenance	26*c*	13

U. S. GOVERNMENT PRINTING OFFICE: 1951—951017

TM 11–964A
*C 4

TECHNICAL MANUAL

RECTIFIERS RA–91–B AND RA–91–C

TM 11–964A
CHANGES No. 4

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *4 September 1963*

TM 11–964A, 15 August 1951, is changed as follows:

(As changed by C 2, 7 Oct 54.) Change the title of the manual to: RECTIFIERS RA–91–B AND RA–91–C.

Page iv. (As added by C 2, 7 Oct 54.) Add figure 1.1 after figure 1.

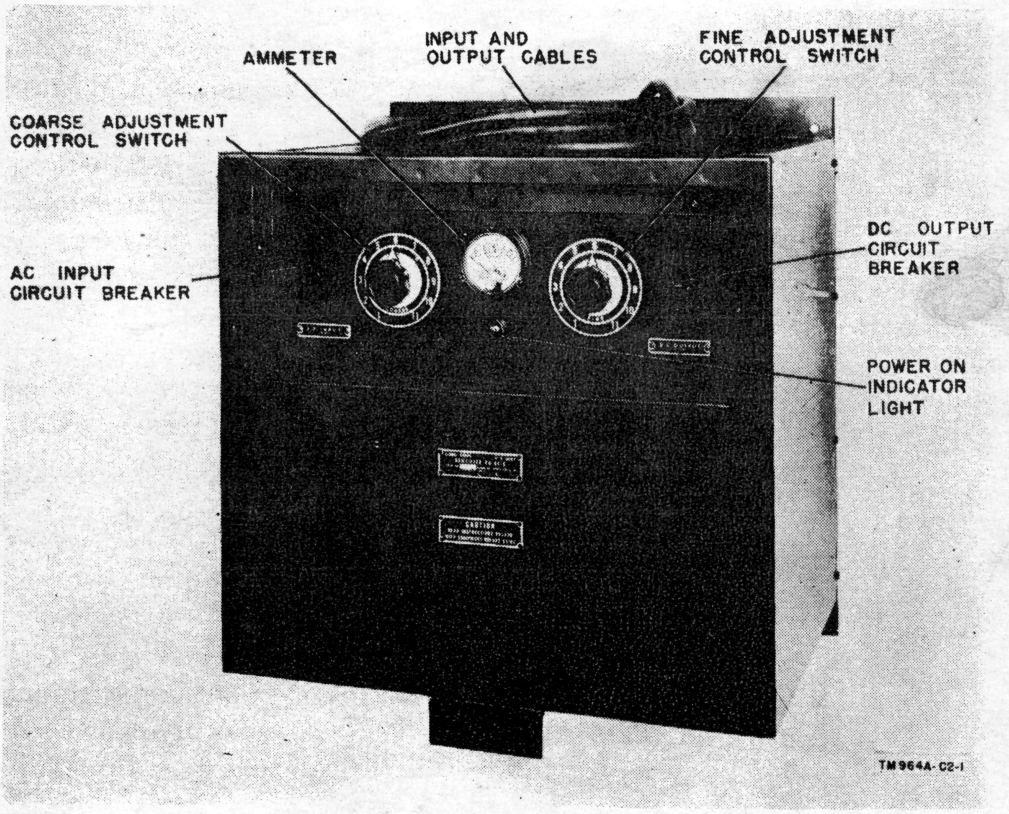

Figure 1.1. Rectifier RA–91–C.

Page 1, chapter 1, notes. (As added by C 2, 7 Oct 54 and C 3, 5 Nov 57.) Delete the notes and substitute:

Note. Rectifier RA–91–C procured on Orders No. 40993–Phila–52, 27657–Phila–53, and 9119–PP–59 are essentially the same as Rectifier RA–91–B except

*These changes supersede C 1, 4 March 1952, C 2, 7 October 1954, and C 3, 5 November 1959.

for minor design changes. Information in this manual applies to all sets unless otherwise specified.

After paragraph 1, add:

1.1. Index of Publications

Refer to the latest issue of DA Pam 310–4 to determine whether there are new editions, changes, or additional publications pertaining to your equipment. DA Pam 310–4 is an index of current technical manuals, technical bulletins, supply bulletins, lubrication orders, and modification work orders that are available through publications supply channels. The index lists the individual parts (–10, –20, –35P, etc) and the latest changes to and revisions of each equipment publication.

(As changed by C 3, 5 Nov 59.) Delete paragraph 2 and substitute:

2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38–750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700–58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71–4 (Air Force).

c. Comments on Manual. Forward all comments on this publication direct to: Commanding Officer, U.S. Army Electronics Materiel Support Agency, ATTN: SELMS–MP, Fort Monmouth, N.J. DA Form 1598 (Record of Comments on Publications), DA Form 2496 (Disposition Form), or letter may be used.

(As changed by C 2, 7 Oct 54.) Paragraph 3*b*. Delete the last sentence and substitute: The RA–91–C is 15½ inches deep, 20 inches wide, and 21¾ inches high; it weighs 195 pounds.

Page 2, paragraph 4. Delete the last sentence added by C 1, 4 Mar 52.

Page 5, paragraph 9 (as changed by C 1, 4 Mar 52). After the first sentence, add: When Rectifier RA–91–B is installed in Panel BD–132, all connections between the rectifier and the panel are made when assembling the equipment and no further connections are required. Make sure that these connections are secure.

Paragraph 10*b*(1) (as changed by C 1, 4 Mar 52). Delete the first sentence and substitute: Rectifier RA–91–B is wired to the panel.

Page 8, paragraph 10*b*(2) *Caution* notice, second line (as changed by C 1, 4 Mar 52). Change "11" to: 1.

Paragraph 11*a*, line 5 (as added by C 3, 5 Nov 59). After the word amperes, add: (RA–91–B) or 6.5 amperes (RA–91–C).

Paragraph 12*a* (as changed by C 1, 4 Mar 52). Make the following changes:

Line 10. Change "maximum" to: minimum.

Line 11. Change "minimum" to: maximum.

Page 9, paragraph 15. (As changed by C 1, 4 Mar 52.) Make the following changes:

Subparagraph *b*. Change "11" to :1.

Subparagraph *d*. Delete subparagraph *d* and substitute:

d. Be sure that the links on the terminal board, at the back of the rectifier are correctly installed for the ac voltage to be used. (Refer to TM 11–2064 and TM 9–6140–200–15 for the proper method of connecting batteries for charging.)

Paragraph 16*b*. (As changed by C 1, 4 Mar 52.) Delete the first sentence and substitute: Turn the COARSE adjustment control switch clockwise from position 1 until the approximate charging rate desired is reached.

Page 10, paragraph 16*c*. (As changed by C 1, 4 Mar 52.) Delete subparagraph *c* and substitute:

c. After setting the COARSE adjustment, make a final adjustment by adjusting the FINE adjustment until the exact charging rate desired is indicated on the ammeter. *The charging rate must never exceed 12 amperes.*

Paragraph 17. (As changed by C 1, 4 Mar 52.) Make the following changes:

Introductory paragraph. Add the following: This charging rate should be between two and five percent of the ampere-hour rating of the battery.

Subparagraph *a*. Delete subparagraph *a* and substitute:

a. Charging Rate. Refer to TM 9–6140–200–15 for complete information on approved charging methods and correct charging rates for lead-acid storage batteries used for signal communication equipment.

Subparagraph *b*(1). Delete the last sentence and substitute: Refer to TM 9–6140–200–15 for correct values of specific gravity.

Subparagraph *c*, line 3. Change "TM 9–2857" to: TM 9–6140–200–15.

Paragraph 18, last sentence. Delete the last sentence changed by C 1, 4 Mar 52, and substitute: The charging rate, however, must never exceed 12 amperes. Refer to TM 9–6140–200–15 for a table of approved charging rates.

Page 11, paragraph 20. Delete the last sentence.

Paragraph 21. Delete the last sentence.

Paragraph 22. Delete the last sentence.

Page 12. Delete chapter 3 and substitute:

CHAPTER 3

MAINTENANCE INSTRUCTIONS

23. Scope of Maintenance

The maintenance duties assigned to the operator of Rectifier RA–91–C are listed below together with a reference to the paragraphs covering the specific maintenance function. The duties assigned do not require tools or test equipment other than those issued with the telephone central office equipment of which the rectifier is a part.

a. Daily preventive maintenance checks and services (par. 27).
b. Monthly preventive maintenance checks and services (par. 27.1).
c. Adjustment of ammeter (par. 16).

24. Tools Required for Maintenance

The tools required for maintenance are the same as those issued with the telephone central office equipment of which the rectifier is a part.

25. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in pargraphs 27 and 27.1 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (pars. 27 and 27.1) outline functions to be performed at specific intervals. These checks and services are to maintain Army equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the *references* column lists illustrations, paragraphs, or manuals that contain supplementary information. If the defect cannot be remedied by the operator, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38–750.

26. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the RA–91–B and RA–91–C are required on a daily and weekly basis unless the equip-

ment is to be placed in storage. In that case, check the equipment as follows:

a. Before the equipment is placed in storage.

b. When the equipment is removed from storage.

c. Paragraph 27 specifies checks and services that must be accomplished daily (operator, first echelon).

d. Paragraph 27.1 specifies *additional* checks and services that must be performed *once* each month (organizational repairman, second echelon).

27. Daily Preventive Maintenance Checks and Services Chart (Operator, First Echelon)

Sequence No.	Item	Procedure	References
1	RA–91–B and RA–91–C.	Check for completeness. Requisition missing parts.	
2	Exterior surfaces.	Clean the exterior of the rectifier including the ammeter glass with a lint-free cloth. ***Warning:*** **Cleaning compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation. Remove stubborn dust and dirt or stains with a rag slightly moistened with cleaning compound.**	
3	Intercabling and connectors.	Check all interconnecting cables and connectors for cracks and breaks. Replace cables that have cracks or broken connectors.	
4	Knobs, dials, and switches.	While making the operating checks (items 5–9), observe that the mechanical action of each knob, dial, and switch is smooth and free of external or internal binding. Tighten loose knobs.	
5	AC INPUT circuit breaker.	Set to ON. Power on indicator (pilot light) lights.	Pars. 11 and 14.
6	DC OUTPUT circuit breaker.	Set to ON. DC OUTPUT indication may be seen on ammeter.	Pars. 11 and 14.
7	Ammeter	Place AC INPUT and DC OUTPUT circuit breakers in ON position. Ammeter registers dc output.	Par. 13.
8	COARSE adjustment control switch.	Set AC INPUT and DC OUTPUT circuit breakers in ON position. Move COARSE adjustment control switch from switch position 1 to switch position 11. There should be an increase in dc output current registered on the ammeter as the switch is moved from 1 to 11.	Par. 12.
9	FINE adjustment control switch.	Set AC INPUT and DC OUTPUT circuit breakers in ON position. Move FINE adjustment control switch from switch position 1 to switch position 11. There should be an increase in dc output current registered on the ammeter as the switch is moved from 1 to 11.	Par. 12.

27.1. Monthly Preventive Maintenance Checks and Services Chart (Organization Repairman, Second Echelon)

Sequence No.	Item	Procedure	References
1	Interior of rectifier.	***Warning:*** **Compressed air is dangerous and can cause serious bodily harm. It can also cause mechanical damage to the equipment. Do not use compressed air to dry parts where cleaning compound has been used. Use a blast of compressed air to blow dust from the interior of the rectifier.**	
2	Binding posts and terminals.	Check for loose connections. Tighten loose connections.	
3	Mounting nuts, bolts, studs, and brackets.	Check for looseness. Tighten loose nuts, bolts, studs, and brackets.	
4	Interior and exterior of rectifier.	Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of the proper paint on bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TM 9–213.	

Page 14, paragraph 28*c*. Make the following changes:

Heading. (As changed by C 3, 5 Nov. 59). Change "(fig. 5)" to: (figs. 5 and 5.1).

Subparagraph *c*, line 3. (As changed by C 2, 7 Oct. 54 and C 3, 5 Nov. 59). After "(fig. 6)" add: Each stack of Rectifier RA–91–C has four terminals (figs. 6.1 and 6.2).

Page 16, figure 5, lower right-hand corner. Change "L–1 25 MH" to: L–1 40 MH.

(As added by C 2, 7 Oct. 54). Add figure 5.1 after figure 5.

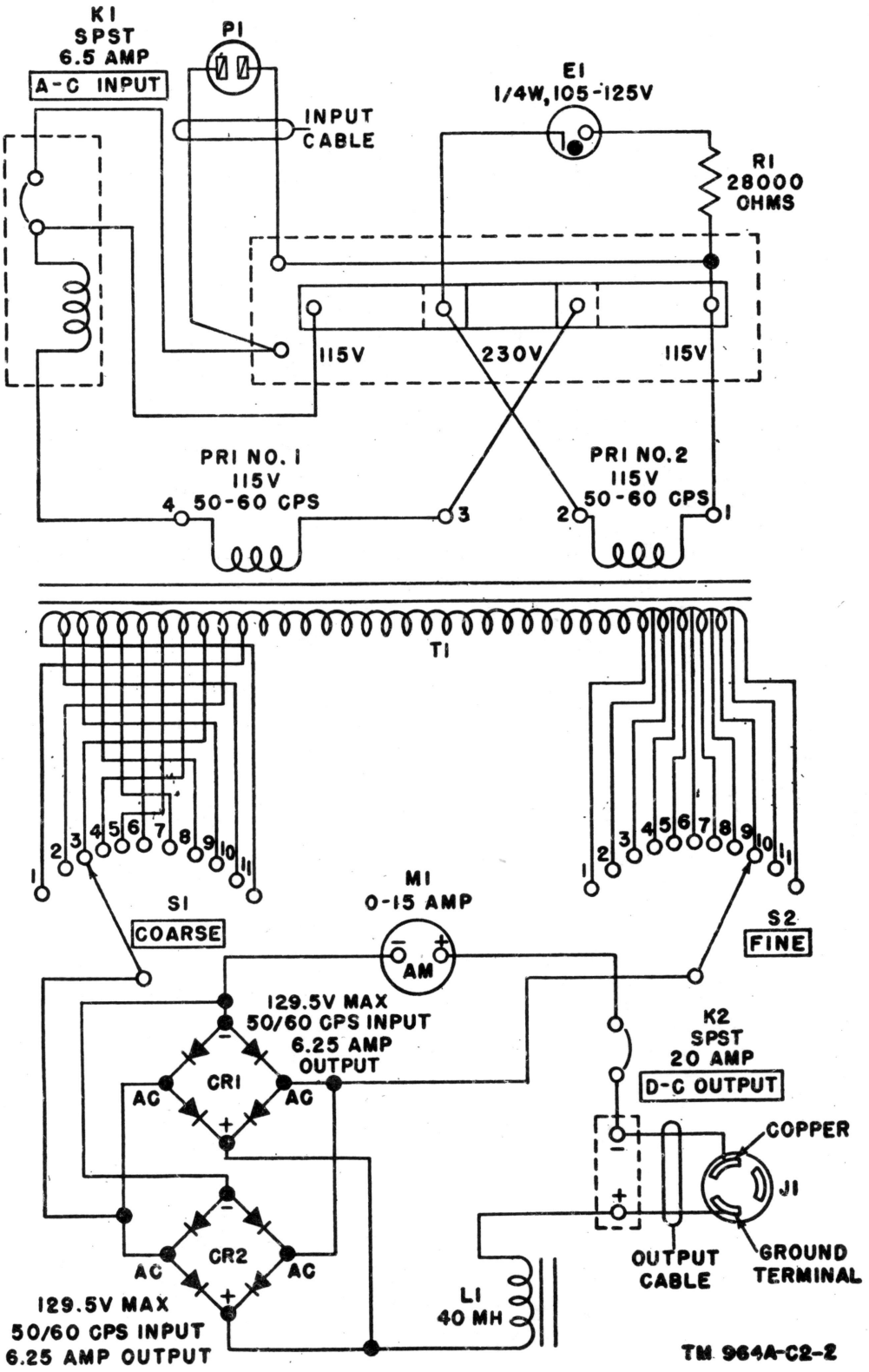

Figure 5.1. Rectifier RA–91–C, schematic diagram.

Page 18, paragraph 34. Make the following changes:

Heading. (As changed by C 3, 5 Nov. 59.) Change "(fig. 6)" to: (figs. 6, 6.1, and 6.2).

Note. (As changed by C 3, 5 Nov. 59.) Delete the first sentence and substitute: The colors indicated on the wiring diagram for Rectifier RA–91–B (fig. 6) refer to the color coding of the wiring.

Subparagraph *a*, line 1. (As changed by C 3, 5 Nov. 59.) Change the first sentence to: Refer to figures 6, 6.1, or 6.2 for a wiring diagram of the equipment.

Page 19, paragraph 34. (As changed by C 3, 5 Nov. 59.) Make the following changes:

Subparagraph *b*(1), line 2. Change "(fig. 6)" to: (figs. 6, 6.1, and 6.2).

Subparagraph *b*(2), line 2. Change "(fig. 6)" to: (figs. 6, 6.1, and 6.2).

Page 20, figure 6. (As added by C 2, 7 Oct. 54 and changed by C 3, 5 Nov. 59.) Add figures 6.1 and 6.2 after figure 6.

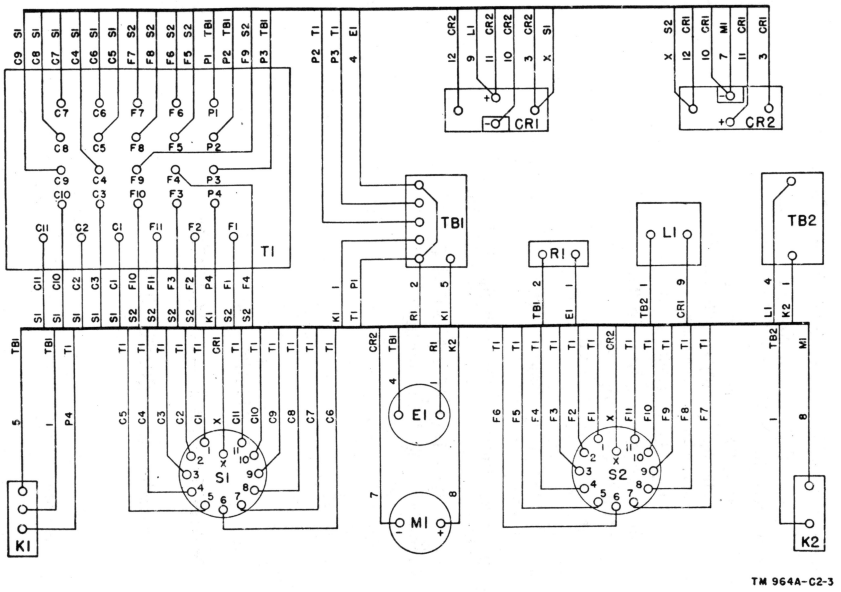

Figure 6.1. Rectifier RA–91–C (except Rectifier RA–91–C on Order No. 9119–PP–59), wiring diagram.

Figure 6.2. Rectifier RA–91–C (Order No. 9119–PP–59).

(Located in back of these changes)

Page 21, paragraph 35, line 4. (As changed by C 3, 5 Nov 59.) Change "(fig. 6)" to: (figs. 6, 6.1, and 6.2).

Page 26. Delete appendix I and substitute:

APPENDIX I

REFERENCES

The references listed below are applicable to the operator and organizational repairman of Rectifiers RA–91–B and RA–91–C.

DA Pam 310–4	Index of Technical Bulletins, Technical Manuals, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TM 9–213	Painting Instructions for Field Use.
TM 9–6140–200–15	Operation and Organizational, Field, and Depot Maintenance: Storage Batteries, Lead-Acid Type.
TM 11–2064	Panels BD–132, BD–132–A, and Power Switchboard SB–361/TT.
TM 38–750	The Army Equipment Record System and Procedures.

Page 29. Delete appendix II as changed by C 1, 4 Mar 52, and rescinded by C 2, 7 Oct 54 and substitute:

APPENDIX II

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

1. General

a. This appendix assigns maintenance functions to be performed on components, assemblies, and subassemblies by the lowest appropriate maintenance echelon.

b. Columns in the maintenance allocation chart are as follows:

(1) *Part or component.* This column shows only the nomenclature or standard item name. Additional descriptive data are included only where clarification is necessary to identify the component. Components, assemblies, and subassemblies are listed in top-down order. That is, the assembles which are part of a component are listed immediately below that component, and the subassemblies which are part of an assembly are listed immediately below that assembly. Each generation breakdown (components, assemblies, or subassemblies) is listed in disassembly order or alphabetical order.

(2) *Maintenance function.* This column indicates the various maintenance functions allocated to the echelons.

(*a*) *Service.* To clean, to preserve, and to replenish lubricants.

(*b*) *Adjust.* To regulate periodically to prevent malfunction.

(*c*) *Inspect.* To verify serviceability and to detect incipient electrical or mechanical failure by scrutiny.

(*d*) *Test.* To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc.

(*e*) *Replace.* To substitute serviceable components, assemblies, or subassemblies, for unserviceable components, assembles, or subassemblies.

(*f*) *Repair.* To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

(*g*) *Align.* To adjust two or more components of an electrical system so that their functions are properly synchronized.

(*h*) *Calibrate.* To determine, check, or rectify the graduation of an instrument, weapon, or weapons system, or components of a weapons system.

(*i*) *Overhaul.* To restore an item to *completely serviceable* condition as prescribed by serviceability standards. This is accomplished through employment of the technique of "Inspect and Repair Only as Necessary" (IROAN). Maximum utilization of diagnostic and test equipment is combined with minimum disassembly of the item during the overhaul process.

(*j*) *Rebuild.* To restore an item to a standard as near as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements using original manufacturing tolerances and/or specifications and subsequent reassembly of the item.

(3) *1st, 2d, 3d, 4th, 5th echelons.* The symbol X indicates the echelon responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated operation.

(4) *Tools required.* This column indicates codes assigned to each individual tool equipment, test equipment, and maintenance equipment referenced. The grouping of codes in this column of the maintenance allocation chart indicates the tool, test, and maintenance equipment required to perform the maintenance function.

(5) *Remarks.* Entries in this column will be utilized when necessary to clarify any of the data cited in the preceding column.

c. Columns in the allocation of tools for maintenance functions are as follows:

(1) *Tools required for maintenance function.* This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

(2) *1st, 2d, 3d, 4th, 5th echelons.* The dagger (†) indicates the echelons normally allocated the facility.

(3) *Tool code.* This column lists the tool code assigned.

2. Maintenance by Using Organizations

When this equipment is used by signal services organizations organic to theater headquarters or communication zones to provide theater communications, those maintenance functions allocated up to and including fourth echelon are authorized to the organization operating this equipment.

Section II. MAINTENANCE ALLOCATION CHART

Part or component	Maintenance function	Echelon					Tools required	Remarks
		1	2	3	4	5		
RECTIFIERS, RA–91, RA–91A, RA–91B, and RA–91C.	service		X				9	
	inspect		X					
				X				Circuit breaker, reactor, metallic rectifier, power transformer.
	test		X				1, 4	Continuity, and comparative test of ammeter.
				X			2, 4, 5	Load capacity, continuity short circuits, resistance to flow of current each direction.
					X		2, 3, 4, 5, 6, 7, 8	All tests.
	repair	X						Replace plugs and fuses.
			X				9	Replace ammeter, power cable, plug connector, handle and knob.
				X			9	Replace circuit breaker, lampholder and light reactor, metallic rectifier, fixed composition resistor, rotary switch, power transformer.
	overhaul				X		9	

Section III. ALLOCATION OF TOOLS FOR MAINTENANCE FUNCTIONS

Tools required for maintenance functions	Echelon					Tool code	Remarks
	1	2	3	4	5		
MULTIMETER, AN/URM–105		(†)				1	
MULTIMETER, TS–352/U			(†)	(†)	(†)	2	
VOLTMETER, METER ME–30/U				(†)	(†)	3	
MULTIMETER, ME–87/U		(†)	(†)	(†)	(†)	4	
AMMETER, ME–65/U			(†)	(†)	(†)	5	
OHMMETER, ZM–21A/U				(†)	(†)	6	
VOLTMETER, IS–185				(†)	(†)	7	
THERMOMETER, MX–1570/G				(†)	(†)	8	
TOOL EQUIPMENT, TE–49		(†)	(†)	(†)	(†)	9	

Page 30. Add appendix III after appendix II.

APPENDIX III

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

1. General

This appendix lists items supplied for initial operation and for running spares. The list includes tools, parts, and material issued as part of the major end item. The list includes all items authorized for basic operator maintenance of the equipment. End items of equipment are issued on the basis of allowances prescribed in equipment authorization tables and other documents that are a basis for requisitioning.

2. Columns

Columns are as follows:

a. Federal Stock Number. This column lists the 11-digit Federal stock number.

b. Designation by Model. The dagger (†) indicates model in which the part is used.

c. Description. Nomenclature or the standard item name and brief identifying data for each item are listed in this column. When requisitioning, enter the nomenclature and description.

d. Unit of Issue. The unit of issue is each unless otherwise indicated and is the supply term by which the individual item is counted for procurement, storage, requisitioning, allowances, and issue purposes.

e. Expendability. Nonexpendable items are indicated by NX. Expendable items are not annotated.

f. Quantity Authorized. Under "Items Comprising an Operable Equipment," the columns lists the quantity of items supplied for the initial operation of the equipment. Under "Running Spare Items" the quantities listed are those initially with the equipment as spare parts. The quantities are authorized to be kept on hand by the operator for maintenance of the equipment.

g. Illustrations. Not used.

Section II. FUNCTIONAL PARTS LIST

Federal stock No.	Designation by model						Description	Unit of issue	Expendability	Quantity authorized	Illustration	
											Figure No.	Item No.
							RECTIFIERS, RA–91, RA–91A, RA–91B, AND RA–91C.					
6130–222–6204							RECTIFIERS RA–91, RA–91A, RA–91B, and RA–91C: metallic rectifier type; 6 to 60 v charging; 12 amp mx taper charging current; input 115/230 vac, 60 cyc, single phase; one ckt for charging 3 to 24 storage cells; ventilated steel case; approx 19¾ in. lg x 15½ in. w x 21½ in. h o/a; MIL spec MIL–R–12540.	----	NX			
							NOTE: Model Column 1 refers to RA–91; column 2 refers to RA–91A; column 3 refers to RA–91B; column 4 refers to RA–91C as procured on order 18586–PH–51; column 5 refers to RA–91C as procured on orders 40993–PH–52, 11659–PH–52, 27657–PH–53, 15756–PH–55, 32047–PH–55, 47549–PH–56, 30861–PH–57; column 6 refers to RA–91C as procured on orders 14386–PC–58, 9119–PP–59, 23312–PC–60.					

Section II. FUNCTIONAL PARTS LIST—Continued

Federal stock No.	Designation by model						Description	Unit of issue	Expendability	Quantity authorized	Illustration	
											Figure No.	Item No.
							ITEMS COMPRISING AN OPERABLE EQUIPMENT					
Order thru AGC	(†)	(†)					TECHNICAL MANUAL TM 11-964			1		
Order thru AGC			(†)	(†)	(†)	(†)	TECHNICAL MANUAL TM 11-964A			1		
							RUNNING SPARE ITEMS					
5920-228-4484	(†)						FUSE, PLUG: MIL type F14D15ROA	ea	NX	2		

By Order of the Secretary of the Army:

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Chief of Staff.

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USASCC (4)
MDW (1)
Armies (2)
Corps (2)
USA Corps (3)
USATC AD (2)
USATC Engr (2)
USATC Inf (2)
USATC Armor (2)
USASTC (5)
Instl (2) except Ft Monmouth (63)
Svc Colleges (2)
Br Svc Sch (2) except GENDEP (OS) (2)
Sig Dep (OS) (12)
Sig Sec, GENDEP (5)
Army Dep (2) except
Ft Worth (8)
Lexington (12)
Sacramento (28)
Tobyhanna (12)
Red River Arsenal (5)
Pine Bluff Arsenal (1)
USA Elct RD Actv, White Sands (13)
USA Elct RD Actv, Ft Huachuca (2)
USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
USAOSA (1)
AMS (1)
WRAMC (1)
AFIP (1)
Army Pic Cen (2)
USA Mbl Spt Cen (1)
USA Elct Mat Agcy (12)
Chicago Proc Dist (1)
USARCARIB Sig Agcy (1)
Sig Fld Maint Shop (3)
Units organized under following TOE's (2 copies each unless otherwise indicated):

5–500 (Tms AA–AD)	11–155
7	11–158
11–5	11–237
11–6	11–500 (Tms AA–AC) (4)
11–7	11–557
11–15	11–592
11–16	11–597
11–35	17
11–36	19–55
11–37	19–56
11–38	19–57
11–55	29–7
11–56	29–56
11–57	37
11–95	39–51
11–96	44–8
11–97	57
11–117	

NG: State AG (3); units—same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used see AR 320–50.

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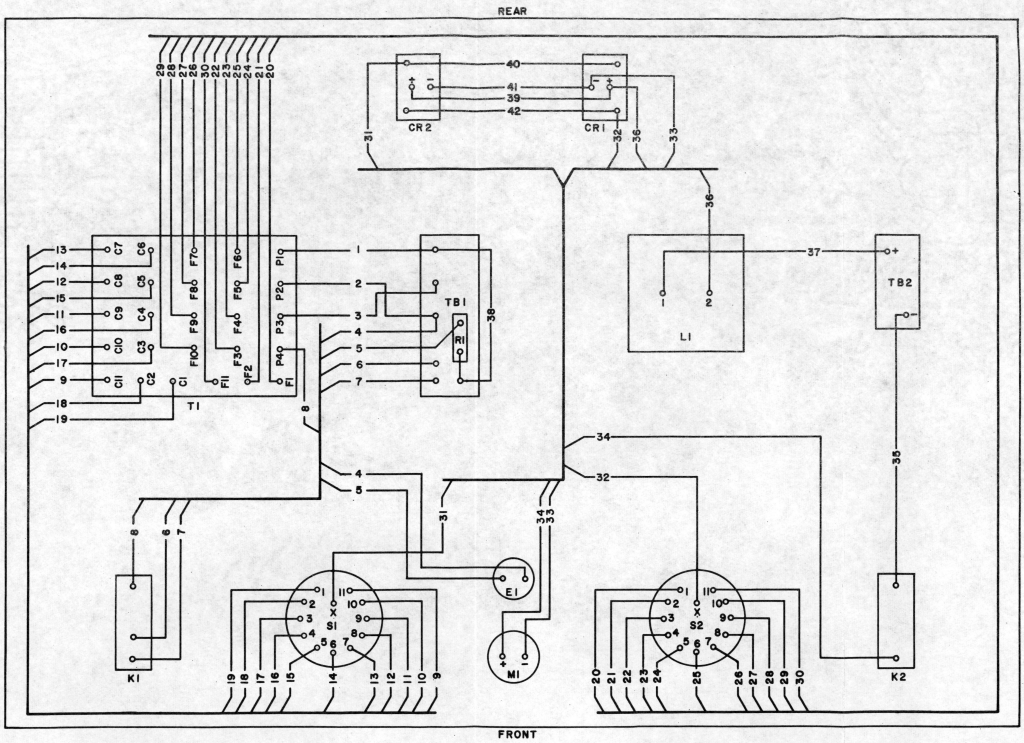

NOTES:

1. WIRE NUMBERS REPRESENT NUMBERED IDENTIFICATION TABS ATTACHED TO EQUIPMENT WIRING.
2. THE ANGLE AT WHICH A SPECIFIC WIRE ENTERS A CABLE INDICATES THE DIRECTION TO FOLLOW TO FIND THE OTHER END OF THIS WIRE.

TM964A-C3-1

Figure 6.2. Rectifier RA–91–C (Order No. 9119–PP–59).